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SOME RESULTS OF USSR SCIENTIFIC RESEARCH WORK ON DISINFECTION AND TASKS TO BE ACCOMPLISHED IN THIS FIELD

[Comment: The following report is a contribution of the Central Scientific Research Disinfection Institute and was written by V. I. Vashkov. According to a footnote in Zhurnal Mikrobiologii, Epidemiologii, i Immunobiologii, in which the report was published, it was approved by the institute's Scientific Council and by a scientific conference held on 3 June 1953.]

Although the workers at disinfection institutes have accomplished much during recent years, they still have important tasks ahead of them.

As far as disinfectants are concerned, one must note that quaternary ammonium bases, to which a high bactericidal effect was formerly ascribed, do not exert any such effect. Detailed investigation has shown that quaternary ammonium bases are effective bacteriostatic agents but do not exhibit a high bactericidal activity. New disinfectants which are more effective than those already being used have not been found hitherto. The principal disinfectants are still chlorine preparations, including chloramine, which was already proposed in 1916. The advisability of disinfecting eliminated matter with dry chloride of lime has been established. Some time ago, activated solutions of chloramine were proposed for this purpose, but they have not been applied extensively anywhere except in the city of Moscow.

It is known that dysentery occupies a special place among intestinal infections. In view of the fact that we have not been able to cope adequately with dysentery hitherto, it would be advisable to evaluate the disinfection measures carried out in connection with this disease and to determine the proper function and significance of disinfection measures in connection with dysentery on the basis of bacteriological and chemical control data. The study of organizational and methodological problems must be included in these investigations.

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One must determine the methods of investigating foci, the time limits within which disinfection must be carried out, the problem of liaison with the therapeutic network, and questions pertaining to the equipment of disinfection detachments and the quality of their work at the focus being disinfected.

Contact plays an important role in the transmission of intestinal infections. Notwithstanding this, no testing of the epidemiological effectiveness of disinfection methods and measures applied under everyday conditions in the presence of carriers of intestinal infections, including patients suffering from chronic dysentery, has been carried out hitherto.

Although strict regulations exist to the effect that 100% hospitalization of patients suffering from intestinal infections must be carried out, some of these patients remain at home, particularly in the summer. For that reason, precise procedures for disinfection at home must be worked out.

In some cases, disinfection procedures at hospitals and at children's institutions are in need of improvement. It is necessary to revise the procedures for disinfection, particularly as far as children's institutions are concerned.

One should pay particular attention to problems of disinfection in connection with tuberculosis. There still is no simple and effective method of disinfecting rooms against tuberculosis. The same applies to disinfection in connection with anthrax. Methods for the disinfection of vertical surfaces have not been developed as yet and there are no satisfactory methods for disinfecting the soil. Procedures for the disinfection of soil are particularly needed now, because old cattle burial grounds are being opened up at large construction works and in connection with the building of canals. Problems of disinfection in connection with tularemia, brucellosis, poliomyelitis, and other diseases have not been investigated adequately. Particular attention should be paid to problems of disinfection in connection with [infectious] jaundice or Botkin's epidemic hepatitis.

Methods of disinfection as applied to all types of fungus diseases and helminth invasions have not been developed adequately. We have not been able to cope adequately with scarlet fever hitherto. Many investigators point out that our disinfection measures in connection with this disease are not adequate. It would therefore be advisable to carry out an extensive study of the existing methods of disinfection from the viewpoint of their applicability in connection with scarlet fever.

At present, differences of opinion exist on the effectiveness of the application of formaldehyde at foci of droplet infections. In connection with that, it would be expedient to check, under practical conditions, the bactericidal effectiveness of the disinfection of hard and soft surfaces by this method.

Of great importance are some problems connected with the disinfection of air which have not yet been adequately investigated. During recent years, a method for the application of bactericidal fogs obtained by the dispersion or evaporation of effective substances has been developed. The substances used are harmless to human beings in small quantities. They are devoid of disagreeable odor or irritating effects on the mucous membranes. Among them are resorcinol, hexylresorcinol, lactic acid, and di-ethylene glycol. The ethers of resorcinol proved to be particularly effective. Some of them have a bactericidal activity which is so high that one gram of the disinfectant evaporated in 600 to 700 cubic meters of air suffices to reduce the quantity of dispersed staphylococci or hemolytic streptococci by more that 99% within 10 minutes. The investigations in question can not be regarded as quantitatively adequate, however. For that reason, the problems of disinfecting air in cases of

droplet infections should be investigated more thoroughly in the near future, particularly with reference to influenza, scarlet fever, poliomyelitis, and some other infections.

Ultraviolet radiation also exerts a bactericidal effect. Since influenza and scarlet fever are the most common diseases, it is advisable to investigate the disinfection of air with ultraviolet rays in connection with these diseases. This work should be carried out at children's institutions during a rise of the incidence of influenza and at hospitals where scarlet fever patients are kept so as to establish to what extent the disinfection of air reduces the transmission of the disease by convalescents in wards where the disinfection has been carried out.

Up to now, work on the disinfection of air has been carried out mainly under laboratory conditions. At present, one should investigate the epidemiolcgical effectiveness of the disinfection of air under practical conditions.

During recent years, renewed attempts have been made to apply ultraviolet radiation to the disinfection of water. This method is used at Yessentuki for the disinfection of mineral water. An attempt has been made to use ultraviolet rays for the disinfection of the water below the bed of the Belaya River in the old water-supply system of Ufa. In the cases mentioned, high-voltage lamps of the PRK-7 type were used. These lamps were installed in suction-pipe conduits. As a result of the application of this procedure, the titer of B. coli in the water was reduced by a factor of two. Under the circumstances, one must assume that the effectiveness of the disinfection of water in such installations is low. This matter should be subjected to further study, together with other problems pertaining to the disinfection of water. The disinfecting effect of UHF (ultrahigh-frequency currents) has been studied under laboratory conditions. It has been established that vegetative forms of micro-organisms perished within 2-3 minutes under the action of UHF, depending on the capacity of the installation. Investigation has shown that tenfold treatment of dyed silk textiles and of wool, linen, and cotton textiles with UHF does not impair the quality of the textiles treated.

The effect of ultrasound on bacteria has been studied by many investigators. However, the data obtained by them are contradictory. The majority of investigators are inclined to believe that ultrasound vibrations traumatize bacterial cells to a certain extent so that microorganisms which are exposed to these vibrations. including B. coli, dysentery bacilli, typhoid bacilli, and luminescent bacteria, are destroyed.

According to the data of Gorlinskaya, Dolgopolova, Kovaleva, and Ruban, wool which is contaminated with anthrax spores and protected because it is covered with blood, is disinfected when exposed to the action of a 0.1-0.15% solution of formaldehyde that contains 0.1% of soap. The spores of anthrax were found to have perished 6 minutes after the beginning of the treatment with ultrasound. In the liquid surrounding the wool, living microorganisms were not found after treatment with ultrasound had been continued for 4 minutes.

Interesting data have been published on the action of ultrasound on viruses. If, before being exposed to ultrasound, the preparation contained a virus consisting of particles which had a dimension of 320 millimicrons, then, after treatment with ultrasound, virus particles having the dimension of 80 millimicrons predominated initially and later, particles having the dimension of 40 millimicrons. A noteworthy result was that in solutions of the virus of tobacco mosaic disease, which had been subjected to the action of ultrasound, the disintegrated virus particles were restored to original size after some time. Kausche expressed the opinion that the action of ultrasound on cells is reversible to a certain extent and that the viability of cells that have been exposed to ultrasound may be restored.

One may state in this connection that a number of special problems in the field of disinfection have arisen in connection with the new theories on the phase development of microorganisms and the interpretation of the nature of viruses and bacteria made from the standpoint of these theories. These problems require urgent solution.

Much attention has always been paid to problems of disinfection in chambers. During recent years, several models of disinfection chambers have been developed, i.e., a chamber with a tray vapor generator, a paraformaldehyde chamber, an electric chamber, etc.

At present, the use of a paraformaldehyde mixture applied at a low temperature (41-51°C) is being introduced for disinfection in paraformaldehyde chambers. The application of this method makes possible the disinfection without spoilage of hides which have a thin flesh-side layer. In the same chambers, using steam-air mixtures at 98°C and treatment for 45 minutes, one may exterminate sporiferous microorganisms. Considerable work has been done on a solution of one of the most difficult problems of disinfection, i. e., the decontamination of rags packed in bales prior to transportation to factories. The method whereby bales weighing 80-100 kilograms and occupying one cubic meter of chamber space are treated at 0.8 atmospheres during 45 minutes proved to be effective.

The data given above with reference to UHF currents, ultrasound, chamber disinfection, and other disinfection procedures indicate that although some work has been done in this field, problems which must be solved still remain.

Although the USSR has very extensive territories in the North, we have not done much work on problems pertaining to disinfection at low temperatures.

The development of equipment for the disinfection of rooms and the extermination of insects in rooms is lagging. The same applies to the disinfection of soil and the extermination of insects in the soil. The absence of equipment for the treatment of the soil is of great significance at present, because ticks, mosquitos, sand flies, and other arthropods which transmit infectious diseases are being exterminated to protect the health of construction workers.

One may indicate in this connection that an apparatus for the mechanical dispersion of powders has been developed at the Central Disinfection Institute and that I. S. Shevyakov, who is active at the Moscow City Disinfection Station, has developed several designs of equipment for wet disinfection. However, the equipment has not yet been introduced into practice. Other disinfection stations do not do any work on the design and perfection of equipment.

One must mention briefly the equipment for the bacteriological testing of air. The centrifuge for capturing microorganisms from the air that has been proposed by Shafir unfortunately has a number of substantial shortcomings and for that reason has not been applied as widely as some other equipment. In 1951, U. A. Krogov proposed an apparatus for the bacteriological testing of air, which, in our opinion, will be applied widely.

One must also mention an apparatus which has been proposed for the bacteriological testing of outside air and which embodies the following principle. A Petri dish containing a solid medium is inserted into a trumpet-shaped pipe. The operator boards an automobile, adjusts the apparatus so that the wide end of the trumpet-shaped tube faces in the direction of the motion of the automobile, and then drives at a definite speed. As the car moves, the air enters the tube and impinges on the agar medium contained in the Petri dish. A part of the microorganisms contained in the air sticks to the medium. In my opinion this method deserves considerable attention and thorough testing.

Workers of sanitary-epidemiological stations who are active at new construction works, where a large number of persons agglomerate who arrive in small, separate groups from various areas, must make every effort to prevent the spread of intestinal, transmissive, and other infections. The experience acquired at these stations must be summarized and applied extensively in practical work.

One must, by all means, carry on propaganda among the population with a view to spreading knowledge on the simplest methods and means of disinfection, extermination of insects, and extermination of rats in such a manner that the population will be induced to carry out prophylactic measures and anti-epidemic disinfection measures in connection with some infections.

In connection with the fact that workers at disinfection institutions must constantly use substances containing chlorine and other toxic chemicals, it is advisable to investigate the occupational injuries to which disinfection workers and disinfection instructors are exposed.

The organization of scientific research work at large disinfection stations is prescribed by several orders of the Ministry of Health USSR. During the past 5 years, scientific work on problems of the organization and methods pertaining to the application of disinfection measures and also on methods for the laboratory control of disinfection was carried out, in addition to work at the Central Scientific Research Disinfection Institute and associated institutes, at the institutions of the following union republics: Azerbaydzhan, Armenian, Byelorussian, Georgian, Kazakh, Kirghiz, Moldavian, Tadzhik, Uzbek, Ukrainian, and RSFSR.

While during the initial years of the postwar Five-Year Plan, the principal attention in the outlying areas was paid to problems of the extermination of insects in connection with the introduction into practical use of synthetic insecticides (50% of all projects dealt with this subject), organizational-methodological work on problems of focal disinfection was increased during the final 2 years.

Scientific work is carried out on the most extensive scale at the Moscow, Voronezh, and Leningrad disinfection stations and at the former Central Scientific Research Laboratory of the Ministry of Health Ukrainian SSR.

The Moscow Disinfection Station works predominantly on problems pertaining to the rationalization of focal disinfection, evaluation of various preparations by applying these preparations practically, measures for combating flies carried out on a large scale, designing of disinfection equipment, and the introduction into practice and improvement of methods for the laboratory control of results achieved by disinfection.

The Leningrad Disinfection Station works on the improvement of methods for the bacteriological control of disinfection, the evaluation of insecticides in practical use, and the improvement of the activity of disinfectants which are already available.

In the field of research on focal disinfection, the Voronezh Disinfection Station works on the perfection of the system of signalization of incidences of infectious diseases, problems of organizational and methodological character in the subdivision of rat-control measures, prophylaxis of pediculosis, and systematic investigation of the operation of the isolation ward. Considerable attention is being paid in work by this institution to the application of new forms of DDT and hexachlorocyclohexane.

An important element in the organization of the extended work done by peripheral institutions on the subject of disinfection are the annual scientific conferences held by the Central Scientific Research Disinfection Institute. At the conference held in 1948, 37 representatives of disinfection stations, sanitary-epidemiological stations, and institutes of epidemiology and microbiology participated. Eight reports emanating from the local institutions were presented at the conference, i. e., 26% of all reports originated in the periphery. At the 1952 annual conference, 83 persons from 14 republics of the

Soviet Union participated. Twenty-three reports from peripheral institutions were heard, i. e., 53% of all reports that had been made. In 1953, 75% of the reports presented at the annual conference were given by representatives of institutions other than the Central Scientific Research Disinfection Institute and only 25% emanated from the institute.

The most important prerequisite for the successful development of disinfection methods and the efficient application of these methods is generalization of the extensive experience acquired by practical workers and the wide participation of these workers in scientific research. Experience shows that it is precisely within the ranks of disinfection workers that new ideas and valuable suggestions originate.

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